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Cover image: This Siamese crocodile was bred in captivity and released in Koh Kong Province in 2014 as part of a pilot project to reinforce Cambodia's depleted wild populations (© Jeremy Holden). The status of this Critically Endangered species in Cambodia is explored by Sam *et al.* in this issue (pages 153–164).

Editorial — The status of botanical exploration and plant conservation in Cambodia

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Mainland Southeast Asia, including Cambodia, is a hotspot for rare and endemic biodiversity (Mittermeier *et al.*, 1999). Unfortunately, some 40% of the region's flora and fauna faces extinction by the end of this century, making it one of the world's most threatened areas for biodiversity (SCBD, 2010). Until the 1970s, Cambodia was a tranquil backwater in the heart of Indochina endowed with extensive forests whose valuable timber was largely unexploited. Cambodia was also noted for some of Southeast Asia's most important wetlands, including mangroves along the Gulf of Thailand.

Cambodia's protected area system is a legacy of its colonial past. By the end of their century-long rule, the French had turned about 20,000 km² into six wildlife reserves and roughly twice as much into 173 forest reserves (RGC, 2010; Poffenberger, 2013). An additional 10,800 ha was set aside around the temples of Angkor, which became Southeast Asia's first national park in 1925. Following independence in 1953, the Cambodian government took control of the wildlife reserves. The Khmer Rouge then abolished these in the 1970s and they remained forgotten for the next decade. It was not until the United Nations arrived in the 1990s that protected areas returned to the country. Conservationists reviewed the colonial protected area system, added lowland evergreen forests which were earlier largely ignored, and expanded what had been 20,000 km² to 33,000 km² (Poffenberger, 2013). In 1993, the year that democratic elections returned to Cambodia, King Norodom Sihanouk signed a royal decree creating 23 protected areas under the jurisdiction of the new Ministry of Environment. The Ministry of Agriculture, Forestry and Fisheries in time established nine others and today, 32 protected areas cover more than a quarter of the country's surface (Save Cambodia's Wildlife, 2014), making it one of the most extensive protected area management systems in Asia.

Various laws govern the management of the country's forests and protected areas, for example a Land Law was issued in 2001, a Forestry Law in 2002, a sub-

decree on economic land concessions in 2005, and finally a Protected Areas Law in 2008. Between 1994 and 1997, timber concessions covering more than six million ha, equalling 35% of Cambodia's land area, were granted by the government and rapid deforestation ensued (Anon., 2004; RGC, 2010). During this period, however, logging concessions remained outside of protected areas, sparing them the worst of the decade's deforestation.

The recent history of Cambodian forest management has been turbulent. Following a decade of anarchic logging, the national concession system was suspended in 2001. However, the government soon began granting economic land concessions (ELCs) which allowed vast amounts of forest clearance for agro-industrial crops (Save Cambodia's Wildlife, 2014). ELCs started appearing in protected areas in 2008 and 2009 and by 2012, the Ministry of Environment had approved 113 ELCs inside its protected areas (ADHOC, 2012; HRC, 2012). New data on forest fires show that the ELCs are targeting the country's best forests (Forest Trends, 2015). According to the latter study, approximately 14% of Cambodia has been allocated to domestic and foreign corporations for development and around 80% of this land is inside protected areas and forest reserves. The latest U.S. MODIS/FIRMS satellite data show that forests inside Cambodia's protected areas are disappearing as fast as forests nationwide, which recently led to the term 'un-protected areas' being coined for the protected area system (Peter & Pheap, 2015).

Botanical research

Although many Cambodian people have a workable knowledge of their country's plants, scientifically it remains one of the least known floras in the region. The flora of Cambodia is closely related to that of its surrounding countries and the Malesiana Region. Connections with other areas are distinctly less important (Dy Phon, 1982). The number of plant species in Cambodia is unknown, but around 2,300–2,400 species are mentioned

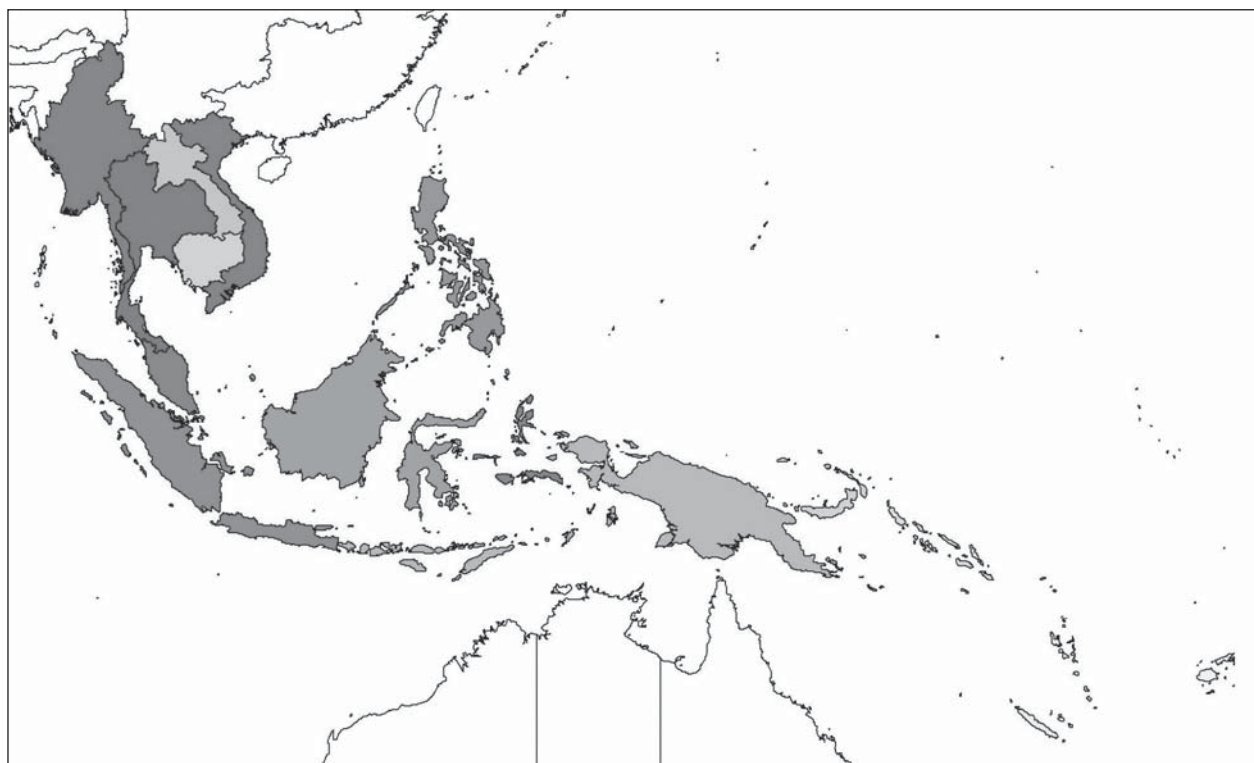


Fig. 1 Map of Southeast Asia showing generic diversity corrected for collecting intensity and area size (Marsh *et al.*, 2009). Generic diversity is shaded from light grey (poor) to dark grey (rich). (Areas in white are excluded from this analysis).

by Dy Phon (1982), Kimsan & Chetha (2013) and Webb *et al.* (2010), with around half of these occurring in South-west Cambodia, particularly the Cardamom Mountains and Elephant Mountains. The number of endemic species is estimated to be around 5–10% (Dy Phon, 1982), while generic diversity is low with no endemic and about 686 native genera recorded. This low generic diversity is shared with Cambodia's northern neighbour Laos, which is also poorly known, but is in startling contrast with Thailand and Vietnam, which are some of the richest countries in the region in terms of their plant diversity (Figure 1, Marsch *et al.*, 2009). This difference is mainly attributable to the relatively flat landscape of Cambodia, but is also due to a lack of botanical research and low plant collection density, with only four collections per 100 km² for Cambodia versus 14 and 50 for Vietnam and Thailand respectively (Newman *et al.*, 2007).

The first western botanist to visit the country was the missionary Piere Poivre (1719–1786) whose collections now form part of the Jussieu herbarium in Paris. The first major plant collector was Clovis Thorel (1833–1911) who was part of the French Mekong Expedition (1866–1868). However, serious botanical explorations did not start until the 1870s and, in particular, after 1900, when J.B.L.

Pierre (1833–1905), A.J.B. Chevalier (1873–1956) and later E. Poilane (1887–1964) began collecting on a large scale (Gagnepain, 1943). Many surveys and species lists were also published (Theilade *et al.*, 2011) and most of these collections are housed in Paris and Saigon (now Ho Chi Minh City), although others exist in herbaria across the world (Frodin, 2001). Although botanical surveys in Cambodia were disrupted from the Second World War to the end of the civil war in 1992, this effort resulted in a several landmark publications such as the *Flore Forestière de Cochinchine* (Pierre, 1879–1907) and the seven volumes of the *Flore Générale de l'Indo-Chine* (Lecomte, 1907–1950) and currently in the *Flore du Cambodge, du Laos et du Viêt Nam* (Aubreville, 1960–present). The latter has now reached 34 installments, treating 84 families, and is the best resource for finding the correct names and information on plants in Cambodia. A field guide to the flora of Cambodia was also published in 2013, which includes 524 species (Leti *et al.*, 2013).

After seizing power in 1975, the Khmer Rouge destroyed all herbaria and libraries and smashed almost all laboratory equipment. They also shattered the education system and 97% of university students and graduates were killed. Of roughly 1,000 academics and intellectu-

als in the Royal University of Phnom Penh (RUPP), only 87 survived, none of whom were botanists. In 2011, the National Herbarium of Cambodia was established in the Department of Biology in the RUPP. This currently has some 12,500 specimens collected in Cambodia over the last 15 years and historical material repatriated by the Muséum National d'Histoire Naturelle, Paris. To illustrate what can be done by a competent botanist and a good herbarium in Cambodia, a single survey of the vegetation of islands on the Mekong River found one new species to science and 23 new country records (one for every 30 specimens collected) for Cambodia (Maxwell, 2009). Furthermore, 15 new country records are reported in this issue of the *Cambodian Journal of Natural History* alone (Schuiteman *et al.*, 2015; Tagane *et al.*, 2015a; Tagane *et al.*, 2015b).

Future prospects for plant conservation in Cambodia

Wet evergreen forests historically covered much the Cardamom and Elephant Mountains and parts of the Annamites adjacent to Vietnam, while evergreen, semi-evergreen and dry dipterocarp forests dominated Northern and central Cambodia (WWF, 2013). Sadly many of these forests, both inside and outside protected areas, have been cleared or severely fragmented and degraded, while only discontinuous bands of flooded forest and mangroves now remain. Furthermore, much of the remaining forest land is slated for conversion to other uses (Save Cambodia's Wildlife, 2014).

Deforestation remains high in the region and forest loss in Cambodia has accelerated faster than any other country in the world since 2001 (Global Forest Watch, 2015). Satellite data compiled by the University of Maryland affirm that the annual rate of forest loss in Cambodia since 2001 increased by 14.4%. Cambodia lost a total of 237,875 ha of tree cover in 2010. Subsequent rates of forest loss have declined, but the country still recorded a loss of 177,969 ha in 2014 (Global Forest Watch, 2015).

As part of global climate talks, the United Nations has promoted Reducing Emissions from Deforestation and Forest Degradation (REDD+). Under this programme, developing countries like Cambodia can potentially obtain financial support from donors to keep their forests and the carbon they store intact. REDD+ has been discussed in Cambodia for several years. In 2009, the country produced a Readiness Plan Idea Note (R-PIN) under the World Bank's Forest Carbon Partnership and in 2011, Cambodia produced its Readiness Preparation Proposal (R-PP). A REDD+ Readiness Roadmap has been developed with funding from UNDP and FAO. A consultation process has also been undertaken to involve

NGOs and community representatives. Unfortunately, neither REDD+ nor FLEGT (Forest Law Enforcement, Governance and Trade) have had a substantial impact on the rate of deforestation in Cambodia. The REDD+ and FLEGT programmes, like protected areas, are so far seen as ineffective in preventing the root causes of deforestation, such as ELCs, logging, mining, quarrying and corruption (Forest Trends, 2015). Sadly, the rapid deforestation witnessed in Cambodia is mirrored across the entire Mekong Region. Forest cover loss in Cambodia, Thailand, Vietnam, Laos, Myanmar and China's Yunnan Province, rose by more than five times between 2001 and 2014 (WRI, 2015). Future projections are not promising, and suggest that the Greater Mekong Subregion, especially Cambodia, Myanmar and Laos, will continue to suffer elevated rates of forest loss (WWF, 2013).

Taxonomists working together with conservationists can provide an invaluable insight into local, regional and global priorities and help design more meaningful and targeted conservation programmes (Bates, 2010). To ensure balanced national and sub-national land-use planning, the relevant legal, policy, and institutional frameworks need to be improved and revised, particularly if the government's National Forest Programme and any proposed FLEGT and REDD+ programmes are to be effective. First and foremost, government commitment at an altogether different level seems necessary to conserve the highly threatened biodiversity of Cambodia and the Greater Mekong Region. Urgent measures are needed to preserve Cambodia's unique natural heritage and curb deforestation. In this context, engaging indigenous and local communities is one of the most effective ways of protecting forests and restoring degraded ecosystems (Porter-Bolland *et al.*, 2012). Areas under the stewardship of indigenous peoples are some of the most pristine in the world. The way they live, the way they act, and the knowledge they have is part of the solution to conservation of biodiversity and sustainability (United Nations, 2015). We suggest a new conservation paradigm is needed to build on government-approved engagement of local communities and civil society in the management and conservation of the country's natural heritage.

We also believe that a more robust forest conservation strategy should encompass a regional vision including different land use types where social and economic needs of local inhabitants, as well as tenure rights and local capacities, are recognised. Further research to understand the institutional arrangements that derive from local governance in favour of tropical forest conservation is therefore recommended.

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